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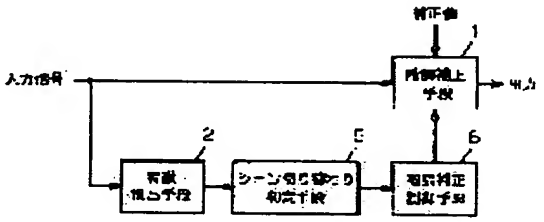
(54) GRADATION CORRECTING DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To restrain adverse effects in the case of image scene switching by gradation correction, when gradation is changed through gradation correction.
SOLUTION: The features of an input signal are detected, the gain of gradation correction is corrected from detected results of the maximum luminance and the minimum luminance, and γ characteristic are corrected from the luminance distribution. From the detection of input signal feature to the gradation correction, when there time delay appears exists to some extent and in gradation correcting device, the gain of gradation correction is set nearly equal to 1, when it is determined as a switchover of a scene.



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[Date of request for examination]

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[Patent number]

[Date of registration]

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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] The gradation compensator which detects the description of an input signal, and sets gain of gradation control to 1 in general from the detection result of the maximum brightness and the minimum brightness when larger than the threshold which has the detection result of the minimum brightness in the gain of gradation amendment when smaller than the threshold which has the detection result of the maximum brightness when amending luminance distribution to gamma characteristics.
[Claim 2] The gradation compensator which detects the description of an input signal and is characterized by to have a feature-detection gradation amendment means amend the detection result of luminance distribution to gamma characteristics for the gain of gradation, a maximum minimum brightness comparison means [a certain threshold / result / of the maximum brightness and the minimum brightness / detection], and the gradation amendment control means that set gain of gradation amendment to 1 in general based on the result of the maximum minimum brightness comparison means from the detection result of the maximum brightness and the minimum brightness.
[Claim 3] The gradation compensator which sets gain of gradation amendment to 1 in general when the description of an input signal is detected and the gain of gradation amendment is judged from the detection result of the maximum brightness and the minimum brightness by the case where there is a certain amount of time lag by gradation amendment from the feature detection of an input signal when amending luminance distribution to gamma characteristics to be the change rate of a scene.
[Claim 4] The gradation compensator which detects the description of an input signal and is characterized from the detection result of the maximum brightness and the minimum brightness by to have a feature-detection gradation amendment means amend the detection result of luminance distribution to gamma characteristics for the gain of gradation, a scene change rate judging means judge the change rate of the scene of an image based on a feature-detection result, and the gradation amendment control means that sets gain of gradation amendment to 1 in general based on the result of a scene change rate judging means.
[Claim 5] It is the gradation compensator to which brightness maximum and the brightness minimum value are quickly changed among detection results, and the detection result of luminance distribution is slowly changed by the case where the description of an input signal is detected, and there is a certain amount of time lag by gradation amendment from the feature detection of an input signal about the gain of the gradation amendment from the detection result of the maximum brightness and the minimum brightness when amending luminance distribution to gamma characteristics.
[Claim 6] A feature detection gradation amendment means to detect the description of an input signal and to amend the detection result of luminance distribution to gamma characteristics for the gain of gradation from the detection result of the maximum brightness and the minimum brightness, A scene change rate judging means to judge the change rate of the scene of an image based on a feature detection result, Based on the IIR filter means which covers an IIR filter over a feature detection result, and a scene change rate judging result, the maximum brightness of a detection result, and the minimum brightness so that it may change quickly The luminance distribution of a detection result is a gradation compensator characterized by having the control means which controls the filter factor of an IIR filter means to change slowly.
[Claim 7] The gradation compensator which generates a detection aperture signal so that the description of an input signal is detected, the horizontal scanning line period H and the vertical-scanning period V may be detected when amending luminance distribution to gamma characteristics for the gain of gradation amendment from the detection result of the maximum brightness and the minimum brightness, and the time lag from termination of a correction value setup to gradation amendment to the following frame may be lost based on the result.

[Claim 8] A feature detection gradation amendment means to detect the description of an input signal and to amend the detection result of luminance distribution to gamma characteristics for the gain of gradation from the detection result of the maximum brightness and the minimum brightness, So that the time lag from termination of a correction value setup to a gradation amendment means to the following frame may be lost based on the result of an HV detection means to detect the horizontal scanning line period H of an input signal, and the vertical-scanning period V, and said HV detection means The gradation compensator characterized by having a detection aperture signal generation means to generate a detection aperture signal.
[Claim 9] The gradation compensator which generates a detection aperture signal so that the horizontal scanning line period H and the vertical-scanning period V may be detected when changing gradation nature based on the detection result of the description of an input signal, and the time lag from termination of a correction value setup to gradation amendment to the following frame may be lost based on the result.
[Claim 10] The gradation compensator characterized by to have a detection aperture signal-generation means generate a detection aperture signal so that the time lag from termination of a correction-value setup to a gradation amendment means to the following frame may be lost based on the result of a gradation amendment means change gradation nature based on the detection result of the description of an input signal, an HV detection means detect the horizontal scanning line period H of an input signal, and the vertical-scanning period V, and said HV detection means.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the gradation compensator which makes a gradation nature improvement of a video signal.
[0002]
[Description of the Prior Art] When the image which is not using all dynamic ranges is generally inputted (for example, when the signal to brightness value "100" - "200" is inputted in the equipment in which a brightness value has the dynamic range of 256 gradation to "0" - "255"), signal processing which adjusts contrast and direct current level so that the maximum brightness value "200" may be made "0" for the minimum brightness value "100" to "255" is performed. Moreover, the feeling of contrast of the intensity level is raised by image which a certain brightness value is concentrating, and processing (it is hereafter described as gradation amendment) used as an image with high visibility is also performed. Furthermore, the technique which detects the histogram of a luminance signal and other characteristic quantity, and it not only uses the maximum brightness value and the minimum brightness value, but carries out gradation amendment as shown in JP,2512562,B is known.
[0003] Since it becomes with [of an image] PATA and gradation amendment is in sight when it changes rapidly when performing the above processings, generally covering an IIR filter over the characteristic quantity or the controlled variable of an image, and preventing the abrupt change of gradation amendment is performed. Furthermore, when the scene of an image changes and the description of an image changes a lot, in order that gradation amendment cannot be followed but evil may come out of it, when the change rate of a scene is judged and it judges with the change rate of a scene, processing in which gradation amendment is changed rapidly is used together. In order to perform such processing flexibly, realizing gradation correction value by the software [flow / to calculate] using a microcomputer is well known for hardware from characteristic quantity in detection and gradation amendment of characteristic quantity.
[0004]
[Problem(s) to be Solved by the Invention] In performing the above processings, in order to detect the description of the image after a scene change rate and to perform gradation amendment, the timing of gradation amendment is overdue to the timing of the scene change rate of an image. When this delay is small, it is as satisfactory as human being sees and does not understand, but when delay is large, the technical problem of a scene that the abrupt change of the gradation amendment depended for changing will be conspicuous, and it will be visible occurs, so that human being sees and understands. However, it is easily unrealizable to make this delay small. It is based on the following reasons.
[0005] Although the IIC bus etc. is widely used in case LSI is controlled from a microcomputer, in the case of such a bus, the time amount which a data transfer takes is required, and response delay arises by the operation of detection of characteristic quantity, characteristic quantity data transfer, and gradation correction value, the data transfer of gradation correction value, and the flow of a series of processings of gradation amendment. It will be based on the data transfer rate of a bus, and response delay may also be 3-4 frames.
[0006] This invention is controlling an IIR filter, a detection aperture signal, or gradation amendment based on the description and scene judging result of an input video signal, in case gradation's is changed with gradation amendments in view of said technical problem, and it aims at oppressing the evil at the time of the image scene change rate by gradation amendment.
[0007]
[Means for Solving the Problem] It is characterized by not being conspicuous and carrying out change of the

gradation amendment at the time of a scene change rate by being close to setting gain of gradation amendment to 1 in general, i.e., an input signal, or outputting the input signal itself, when the gradation compensator of this invention detects the description of an input signal, the change rate of a scene is judged from a detection result and it judges with the change rate of a scene, in order to solve said technical problem.

[0008]
[Embodiment of the Invention] [when invention of this invention according to claim 1 detects the description of an input signal and it amends gamma characteristics for the gain of the gradation amendment from the detection result of the maximum brightness and the minimum brightness from luminance distribution] When smaller than a threshold with the detection result of the maximum brightness, or when larger than a threshold with the detection result of the minimum brightness, by setting gain of gradation control to 1 in general, it has an operation of controlling the white hit or black crushing by control delay in the following image.
[0009] A feature detection gradation amendment means for invention according to claim 2 to detect the description of an input signal, and to amend the detection result of luminance distribution to gamma characteristics for the gain of gradation from the detection result of the maximum brightness and the minimum brightness, The maximum minimum brightness comparison means [a certain threshold / result / of the maximum brightness and the minimum brightness / detection], It has an operation of controlling the white hit and black crushing of an image by gradation amendment, by having had the gradation amendment control means which sets gain of gradation amendment to 1 in general based on the result of the maximum minimum brightness comparison means.
[0010] [when invention according to claim 3 detects the description of an input signal and it amends gamma characteristics for the gain of the gradation amendment from the detection result of the maximum brightness and the minimum brightness from luminance distribution] By the case where there is a certain amount of time lag by gradation amendment from the feature detection of an input signal, when it judges with the change rate of a scene, it has an operation of it not being conspicuous and carrying out change of the gradation amendment at the time of a scene change rate, by setting gain of gradation amendment to 1 in general.
[0011] A feature detection gradation amendment means for invention according to claim 4 to detect the description of an input signal, and to amend the detection result of luminance distribution to gamma characteristics for the gain of gradation from the detection result of the maximum brightness and the minimum brightness, By having had a scene change rate judging means to judge the change rate of the scene of an image based on a feature detection result, and the gradation amendment control means which sets gain of gradation amendment to 1 in general based on the result of a scene change rate judging means It has an operation of it not being conspicuous and carrying out change of the gradation amendment at the time of a scene change rate.
[0012] [when invention according to claim 5 detects the description of an input signal and it amends gamma characteristics for the gain of the gradation amendment from the detection result of the maximum brightness and the minimum brightness from luminance distribution] By the case where there is a certain amount of time lag by gradation amendment from the feature detection of an input signal It has an operation of it not being conspicuous and carrying out change of the gradation amendment at the time of a scene change rate, by changing brightness maximum and the brightness minimum value quickly among detection results, and changing the detection result of luminance distribution slowly.
[0013] A feature detection gradation amendment means for invention according to claim 6 to detect the description of an input signal, and to amend the detection result of luminance distribution to gamma characteristics for the gain of gradation from the detection result of the maximum brightness and the minimum brightness, A scene change rate judging means to judge the change rate of the scene of an image based on a feature detection result, Based on the IIR filter means which covers an IIR filter over a feature detection result, and a scene change rate judging result, the maximum brightness of a detection result, and the minimum brightness so that it may change quickly By having had the control means which controls the filter factor of an IIR filter means to change slowly, the luminance distribution of a detection result has an operation of it not being conspicuous and carrying out change of the gradation amendment at the time of a scene change rate.
[0014] [when invention according to claim 7 detects the description of an input signal and it amends gamma characteristics for the gain of the gradation amendment from the detection result of the maximum brightness and the minimum brightness from luminance distribution] It has an operation that gradation amendment can

be performed early [one frame] conventionally, by generating a detection aperture signal so that the horizontal scanning line period H and the vertical-scanning period V may be detected and the time lag from termination of a correction value setup to gradation amendment to the following frame may be lost based on the result.

[0015] A feature detection gradation amendment means for invention according to claim 8 to detect the description of an input signal, and to amend the detection result of luminance distribution to gamma characteristics for the gain of gradation from the detection result of the maximum brightness and the minimum brightness, So that the time lag from termination of a correction value setup to a gradation amendment means to the following frame may be lost based on the result of an HV detection means to detect the horizontal scanning line period H of an input signal, and the vertical-scanning period V, and this HV detection means By having had a detection aperture signal generation means to generate a detection aperture signal, it has an operation that gradation amendment can be performed early [one frame] conventionally.

[0016] Invention according to claim 9 has an operation that gradation amendment can be performed early [one frame] conventionally, by generating a detection aperture signal so that the horizontal scanning line period H and the vertical-scanning period V may be detected when changing gradation nature based on the detection result of the description of an input signal, and the time lag from termination of a correction value setup to gradation amendment to the following frame may be lost based on the result.

[0017] A gradation amendment means by which invention according to claim 10 changes gradation nature based on the detection result of the description of an input signal, So that the time lag from termination of a correction value setup to a gradation amendment means to the following frame may be lost based on the result of an HV detection means to detect the horizontal scanning line period H of an input signal, and the vertical-scanning period V, and HV detection means By having had a detection aperture signal generation means to generate a detection aperture signal, it has an operation that gradation amendment can be performed early [one frame] conventionally.

[0018] (Gestalt 1 of operation) Drawing 1 is an example of the block diagram of the gradation compensator of this invention. It is a gradation amendment means by which 1 raises the gradation nature of an input video signal in drawing 1 . 2 is a feature detection means to detect the description of an input video signal, and 3 is a maximum minimum brightness comparison means to compare with a threshold the maximum brightness and the minimum brightness which were detected with the feature detection means 2. 4 is a gradation amendment control means which sets gain of gradation amendment to 1, when the maximum brightness is made to 255 and it makes [the minimum brightness] all the same value for the luminance distribution of 0 or 4 brightness fields in response to the result of the maximum minimum brightness comparison means 3.

[0019] Drawing 4 is drawing having shown the minimum brightness behind the IIR filter at the time of using the minimum brightness and this invention behind the IIR filter when not using the example and this invention of time amount change of the maximum [in front of an IIR filter], and the minimum brightness as an example of black crushing control.

[0020] Moreover, drawing 5 is drawing having shown the maximum brightness behind the IIR filter at the time of using the maximum brightness and this invention behind the IIR filter when not using the example and this invention of time amount change of the maximum [in front of an IIR filter], and the minimum brightness as an example of white hit control.

[0021] Drawing and drawing 9 which showed the signal input-output behavioral characteristics at the time of the condition of ** of drawing 5 in case drawing and drawing 8 which showed the signal input-output behavioral characteristics at the time of the condition of ** of drawing 4 when drawing and drawing 7 which showed the signal input-output behavioral characteristics at the time of the condition of ** of drawing 4 in case drawing 6 does not use this invention use this invention do not use this invention are drawing having shown the signal input-output behavioral characteristics at the time of the condition of ** of drawing 5 at the time of using this invention.

[0022] Concrete actuation is explained below. An input video signal is first inputted into the gradation amendment means 1 and the feature detection means 2. The gradation amendment means 1 explains henceforth as what is being considered as polygonal-line approximation in four straight line for simplification. It cannot be overemphasized that the same is said of for example, 8 straight-line approximation of those other than 4 straight lines, of course.

[0023] Gradation amendment is performed so that the video signal inputted into the gradation amendment means 1 may usually raise the gradation of the intensity-level circumference with large frequency from the result of the brightness Wakebe detection means 4. With the feature detection means 2, paying attention to

the video signal of 1 frame time, the luminance distribution of the maximum brightness, the minimum brightness, and it and four intensity-level fields is detected, and each value is outputted. With the maximum minimum brightness comparison means 3, when the maximum brightness is smaller than the threshold over the maximum brightness as compared with the threshold beforehand set up to each in the maximum brightness outputted from the feature detection means 2, and the minimum brightness, or when the minimum brightness is larger than the threshold over the minimum brightness, gain of gradation amendment is set in general to 1. Although gain was set in general to 1 in this example, it is not necessary to be necessarily 1.

[0024] Drawing 2 explains an example of actuation of the gradation amendment means 1. The luminance distribution of an input video signal is detected first. With the feature detection means 2, it detects in which intensity level about 256 gradation from "0" to "255" of an input signal, the intensity level to detect is divided into the field of four intensity levels, "0-63", "64-127", "128-191", and "192-255", and each pixel of an image is in it. The example of the frequency in which each intensity level was detected is shown in drawing 2 . In this example, there are few pixels of an intensity level "0-63", and they show the detection result with many pixels of "64-127." Since that such a detection result means has few pixels of an intensity level "0-63", in view of the whole image, gradation nature is not so important, but since there are many pixels of an intensity level "64-127", I hear that the gradation nature of this level is important, and there is. This realizes the input-output behavioral characteristics according to the number of pixels of four intensity levels.

[0025] The input-output behavioral characteristics in the case of an above-mentioned example are shown in drawing 3 . In an intensity level "0-63", since gradation nature is not important, in order for an output to become small and to raise gradation nature with an intensity level "64-127" conversely to an input, an output becomes large to an input. As mentioned above, with the gradation amendment means 1, gradation amendment according to a luminance distribution situation is performed, and a video signal is outputted.

[0026] When the maximum brightness and the minimum brightness change like drawing 4 , since the minimum brightness behind the IIR filter when not using this invention changes gently like drawing 4 , in ** of drawing 4 , black crushing generates it like drawing 6 . Since the minimum brightness is set to 0 on the other hand when this invention is used and the maximum brightness becomes smaller than a threshold like drawing 4 , in **, black crushing does not happen like drawing 7 .

[0027] Moreover, when the maximum brightness and the minimum brightness change like drawing 5 and it is ** of drawing 5 , in not using this invention, it becomes input-output behavioral characteristics as shown in drawing 8 , and when this invention is used, it becomes input-output behavioral characteristics as shown in drawing 9 . When drawing 8 is compared with drawing 9 , drawing 9 is understood that the brightness range where a white hit happens compared with drawing 8 is narrow. Therefore, a white hit is controlled when this invention is used.

[0028] When larger than a threshold with the minimum brightness similarly, black crushing and a white hit are controlled by setting gain of gradation amendment to 1 in general on a scene with the larger minimum brightness than a threshold, and a subsequent scene.

[0029] [when according to this configuration detecting the description of an input signal and amending gamma characteristics for the gain of the gradation amendment from the detection result of the maximum brightness and the minimum brightness from luminance distribution] By setting gain of gradation control to 1, when smaller than a threshold with the detection result of the maximum brightness, or when larger than a threshold with the detection result of the minimum brightness It becomes possible to control the white hit or black crushing by control delay in the scene which continues after a scene with the maximum brightness smaller than a threshold, scenes with the larger minimum brightness than a threshold, and those scenes.

[0030] (Gestalt 2 of operation) Drawing 10 is used and explained about the gestalt of another 1 operation of this invention below. In addition, about the same configuration as the gestalt of operation mentioned above, explanation is omitted using the same sign.

[0031] In drawing 10 , 5 is a scene change rate judging means to judge the change rate of the scene of an image based on the detection result of the feature detection means 2, and 6 is a gradation amendment control means which sets gain of gradation control to 1, when judged with a scene change rate with the scene change rate judging means 5. Drawing 11 is drawing having shown the input-output behavioral characteristics just behind the scene change rate which does not use the input-output behavioral characteristics and this invention in front of a scene change rate, and the input-output behavioral characteristics just behind the scene change rate using this invention.

[0032] Concrete actuation is explained below. Drawing 12 explains an example of actuation of the scene

change rate judging means 5. From the average luminance in every frame of the input video signal detected with the feature detection means 2, the absolute value of the difference of the average luminance of the present frame and the average luminance of one frame ago is calculated, if it is beyond a threshold with it, it judges with a scene change rate, and the result of a scene change rate judging is outputted. In response to the result of the scene change rate judging means 5, if the gradation amendment control means 6 is a scene change rate, it will set gain of gradation amendment to 1.

[0033] For example, as shown in drawing 12 , compared with change to the input-output behavioral characteristics just behind the scene change rate which does not use this invention from the input-output behavioral characteristics in front of a scene change rate, the change to the input-output behavioral characteristics of the gain 1 at the time of using this invention from the input-output behavioral characteristics in front of a scene change rate has a small change of gradation amendment. Therefore, this invention oppresses that change of gradation amendment is noticeable.

[0034] (Gestalt 3 of operation) In drawing 13 , 7 is the IIR filter means which covers an IIR filter over the detection result of the feature detection means 2, and 8 is an IIR filter factor control means which receives the result of the scene change rate judging means 5, and controls the filter factor of the IIR filter means 7. Drawing 14 is the example of the input-output behavioral characteristics just behind the scene change rate at the time of using the input-output behavioral characteristics and this invention just behind the scene change rate when not using the input-output behavioral characteristics and this invention in front of a scene change rate.

[0035] When the result of the scene change rate judging means 5 is not a scene change rate, the IIR filter factor control means 8 of drawing 13 The filter factor of the IIR filter means 7 is controlled so that the characteristic quantity detected with the feature detection means 4 changes gently. When the result of the scene change rate judging means 5 is a scene change rate, luminance distribution controls the filter factor of the IIR filter means 7 to change gently so that the maximum brightness and the minimum brightness change quickly among the characteristic quantity which the feature detection means 4 detected. For example, if it compares the input-output behavioral characteristics of just before a scene change rate and an immediately after in not using this invention as shown in drawing 14 , the forms differ greatly. It is changing as width of face should spread on the other hand, if the input-output behavioral characteristics of just before a scene change rate and an immediately after are compared when this invention is used, and the near form is not changing. Thus, it is possible by using this invention for gradation amendment change at the scene change rate to become small, and for it not to be conspicuous and to carry out change of gradation amendment.

[0036] (Gestalt 4 of operation) In drawing 15 , 9 is the horizontal scanning line period H and V detection means of detecting the horizontal scanning line period H of a video signal, and the vertical-scanning period V, and 10 is a detection aperture signal generation means to generate the aperture signal of feature detection in response to the result of the horizontal scanning line period H and V detection means 9. Drawing 16 is the example of the time flow of the gradation amendment when not using this invention. Drawing 17 is the example of the time flow of the gradation amendment at the time of using this invention.

[0037] Usually, even when correction value data transfer is completed like drawing 16 in the middle of a frame in order to make it change synchronizing with a frame for example, gradation amendment becomes the following frame and actually being reflected in gradation amendment has the time amount useless [amendment] from termination of data transfer to the following frame. Then, you can make it conventionally reflected in gradation amendment early [one frame] by shifting with a frame and generating a detection aperture signal so that detection may be brought forward by this useless time amount as shown in drawing 17 . In addition, even if it shifts the detection aperture signal of feature detection with a frame, detection of the description of an image and a scene change rate judging can be performed without a problem.

[0038]

[Effect of the Invention] As mentioned above, according to this invention, in case gradation is changed with gradation amendments, it becomes possible to oppress the evil by gradation amendment by controlling a detection result from the description of an input video signal, or bringing [controlling gradation amendment from the description of an input video signal, or] feature detection forward.

[Translation done.]

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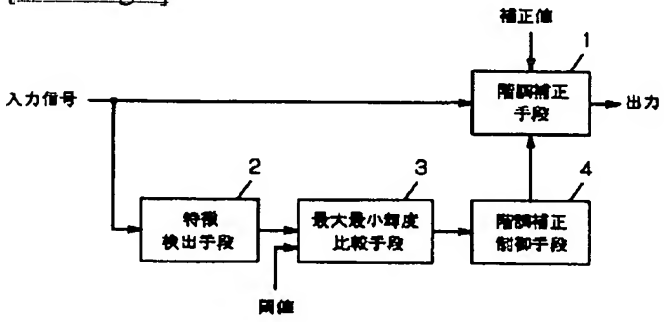
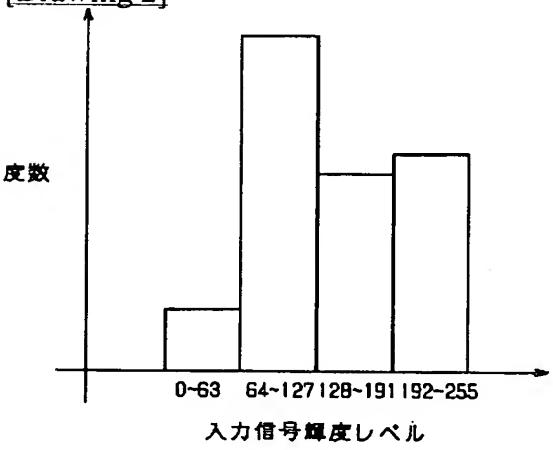
DRAWINGS

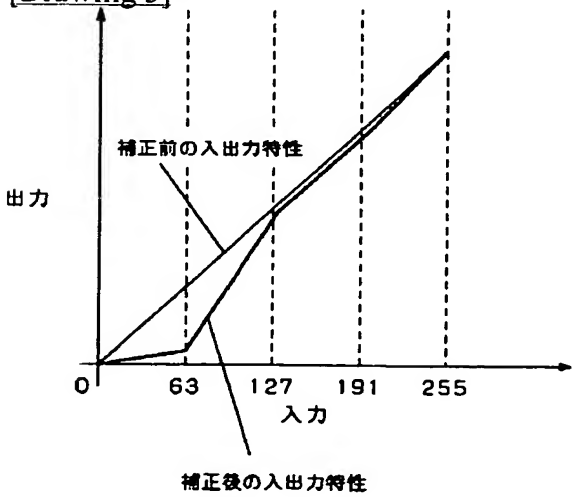
[Drawing 1]



[Drawing 2]



[Drawing 3]



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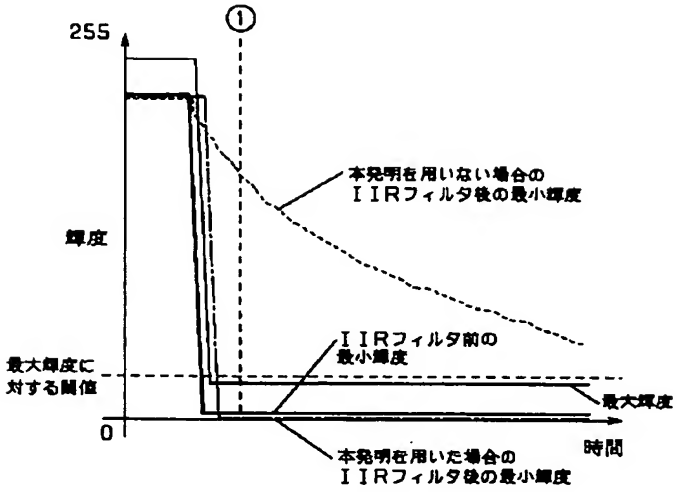
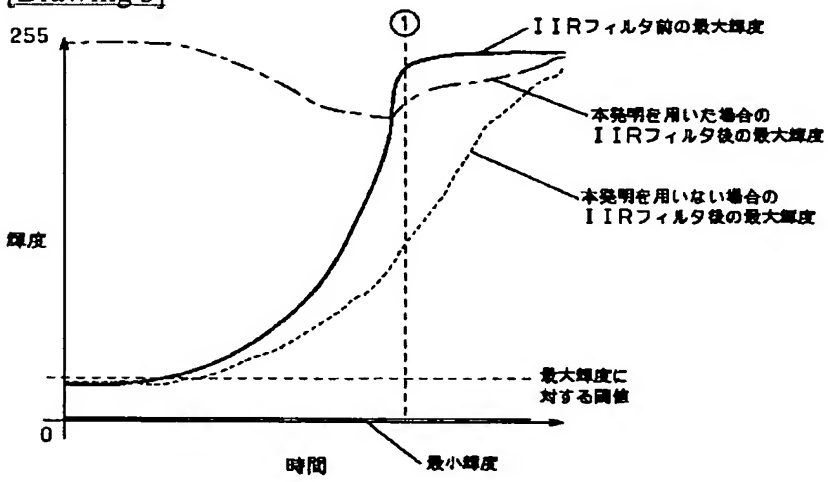
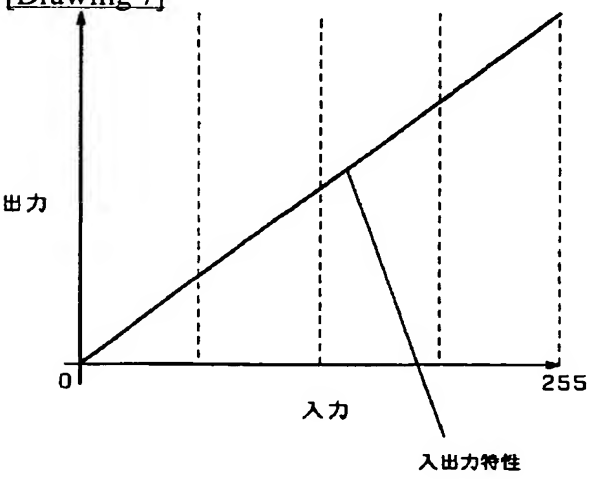


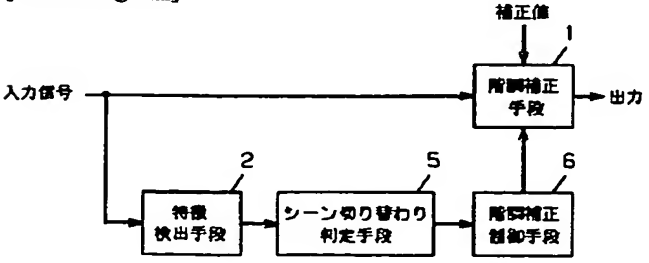
[Drawing 5]



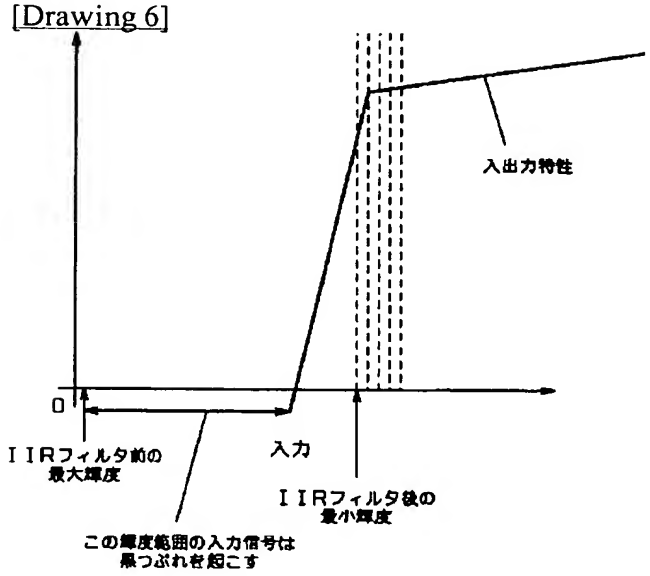
[Drawing 7]



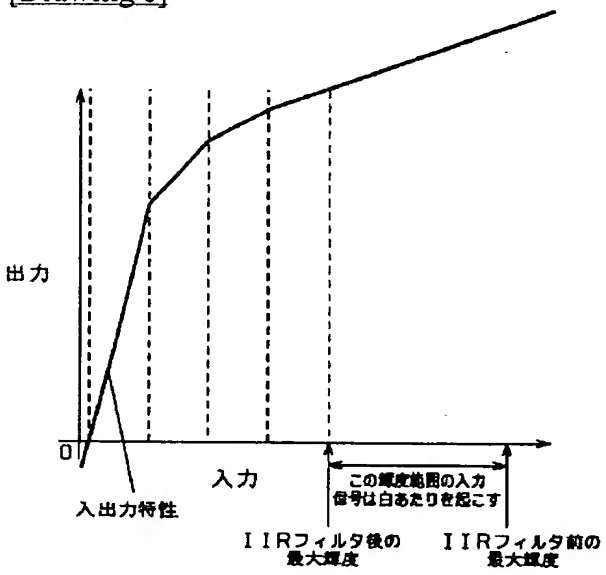
[Drawing 10]



[Drawing 6]



[Drawing 8]



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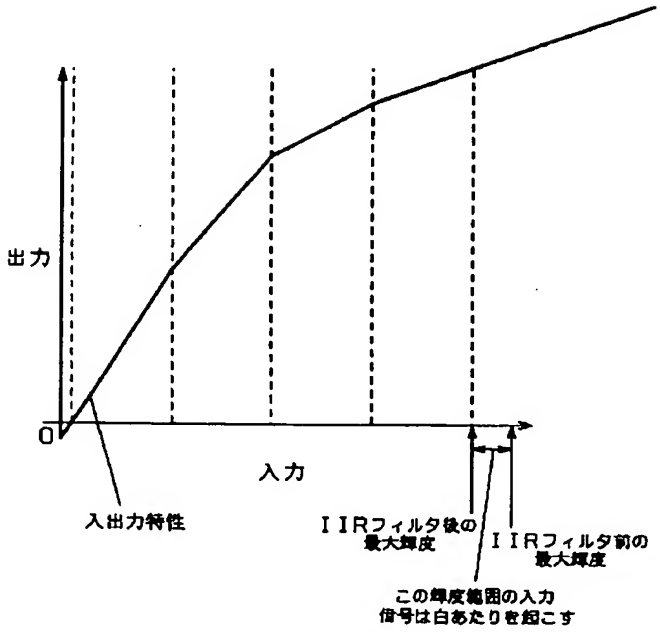
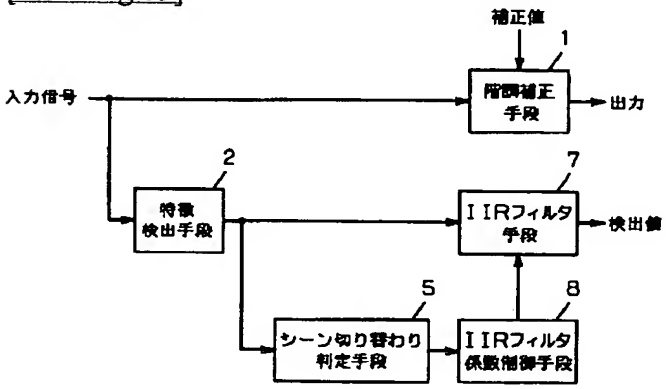
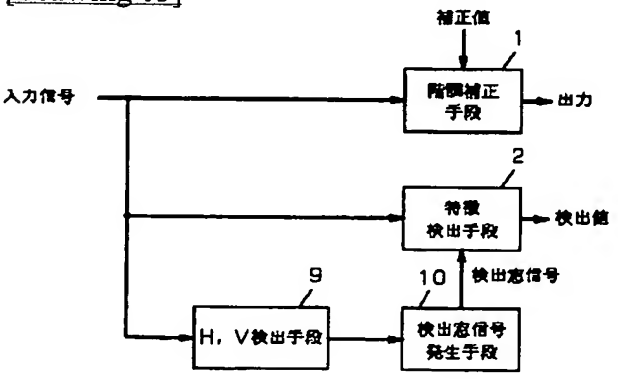


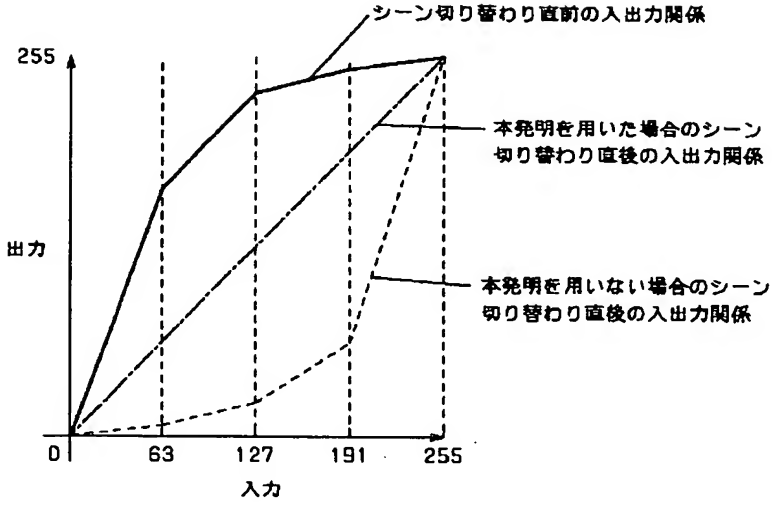
[Drawing 13]



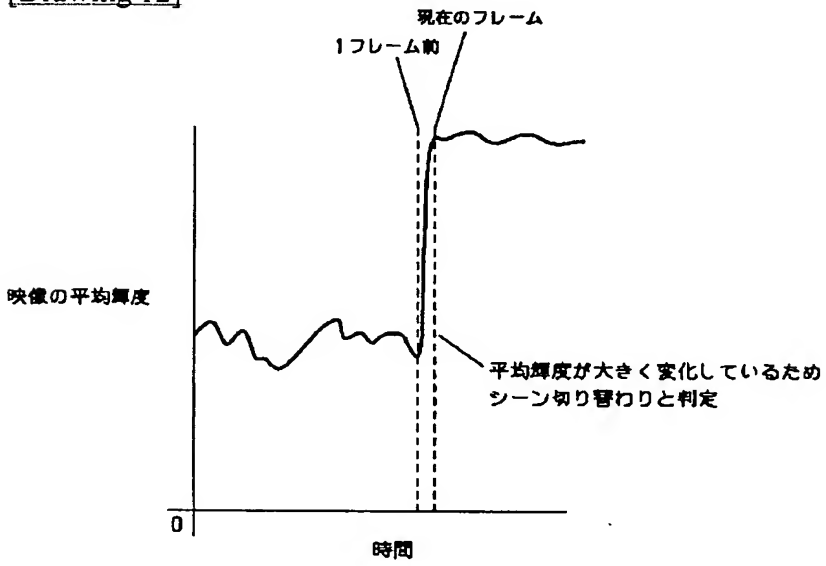
[Drawing 15]



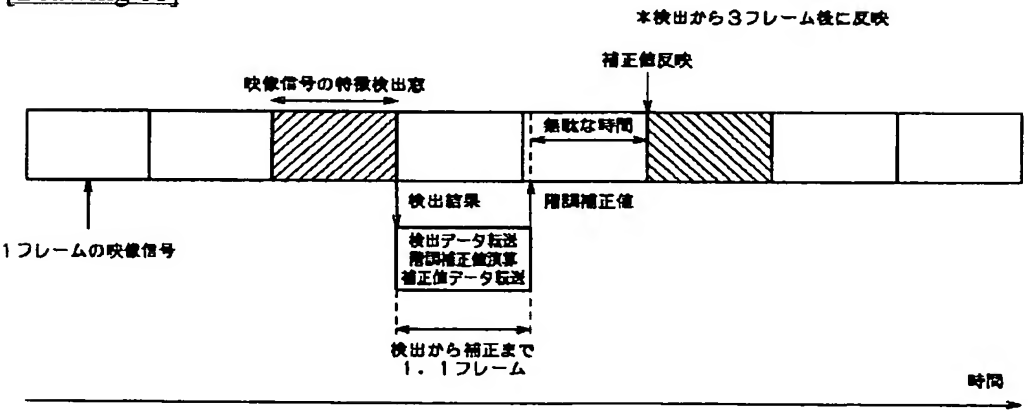
[Drawing 11]



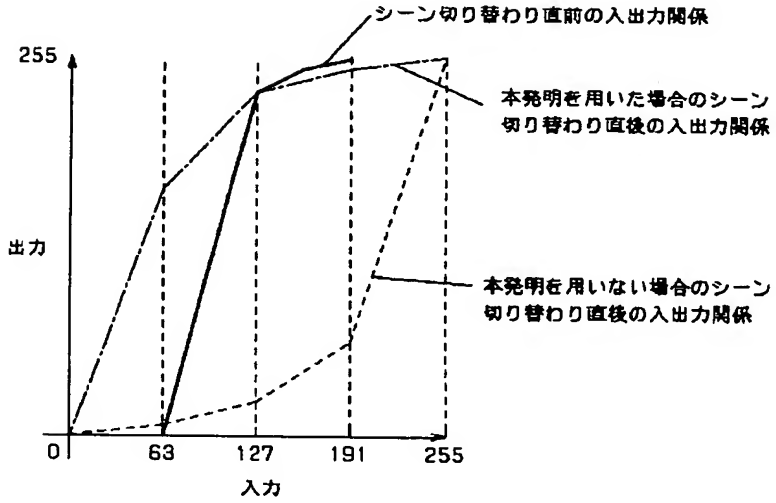
[Drawing 12]



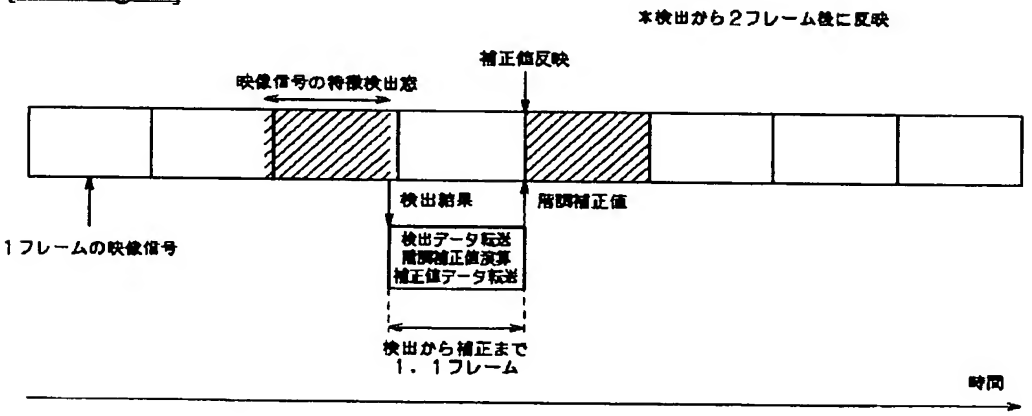
[Drawing 16]



[Drawing 14]



[Drawing 17]



[Translation done.]